

Asteroid and Lava Tube In Situ Resource Utilization (ISRU) Prospecting Free Flyer (ALTIP Free Flyer)

Completed Technology Project (2014 - 2015)



Project Introduction

This project seeks to develop a small free flyer that can be used to safely and effectively prospect on an Asteroid while being controlled by the crew. This will enable the characterization of the Asteroid for the **In Situ Resource Utilization (ISRU)**. Lava tubes can be explored remotely from the outside.

Asteroids can contain vast amounts of resources such as water for propellants and metals for feed stocks. Lava Tubes on Mars and the Moon may contain frozen volatile resources. Before the resources can be used, they must be found with a prospecting method.

The NASA Agency Asteroid Grand Challenge seeks new ideas for Asteroid retrieval mission technologies for exploration and utilization of asteroids in a Distant Retrograde Orbit (DRO).

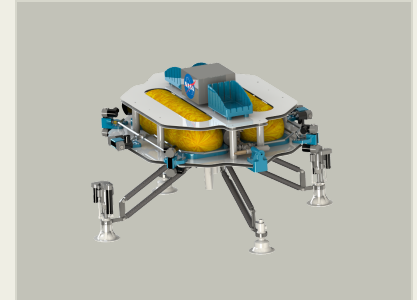
This project will develop a small free flying platform that can be used to safely and effectively prospect on an Asteroid with limited autonomy while being controlled by the crew. This will enable the characterization of the Asteroid for ISRU. Lava tubes can be explored remotely from the outside as well using this same technology.

A small free flyer or even multiple small free flyers are a low risk solution for prospecting and sampling an asteroid, or other Near Earth Objects (e.g. Comets). An evolved application is flying into Mars and lunar lava tubes to look for resources, map the sub surface cavities and acquire samples. Instead of risking a highly expensive main spacecraft bus in a rendezvous asteroid landing, the small free flyer can be used as a secondary spacecraft. The Rosetta mission recently demonstrated how difficult it is to autonomously land on a small body. A small free flyer would have less inertia and be easier to control. The trend in modern spaceflight is towards miniaturization, as electronics and other components shrink in size and mass. The small size also has advantages in terms of maneuverability and access. Multiple small free flyers could provide redundancy and increase mission success probabilities, since an anomaly could be quickly corrected through the use of a second small free flyer.

By prospecting and sampling multiple locations on an Asteroid or lava tube, then geologic mapping and resource characterization is enabled. The crew can control such free flyers with tele-operation without risking direct contact with an extremely dusty or hard to access surface locations. The first step in ISRU is prospecting and characterization of the accessible resources and this will lead to massive risk reduction for actual ISRU in follow-on missions.

Anticipated Benefits

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This small marsupial free flyer is designed to capture samples at an Asteroid for ISRU prospecting purposes.

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Commercial space companies can mine resources in space to provide viable products which will start a new space economy.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Kennedy Space Center (KSC)	Lead Organization	NASA Center	Kennedy Space Center, Florida

Co-Funding Partners	Type	Location
Embry-Riddle Aeronautical University-Daytona Beach	Academia	Daytona Beach, Florida
Honeybee Robotics, Ltd.	Industry	Pasadena, California

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Kennedy Space Center (KSC)

Responsible Program:

Center Innovation Fund: KSC CIF

Project Management

Program Director:

Michael R Lapointe

Program Manager:

Barbara L Brown

Project Manager:

Robert P Mueller

Principal Investigators:

Robert P Mueller

Michael A Dupuis

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Primary U.S. Work Locations

Florida

Images



Free Flyer for ISRU Asteroid Prospecting

This small marsupial free flyer is designed to capture samples at an Asteroid for ISRU prospecting purposes.

(<https://techport.nasa.gov/image/16589>)

Stories

Drones in Space! NASA's Wild Idea to Explore Mars (Video)
(<https://techport.nasa.gov/file/22096>)

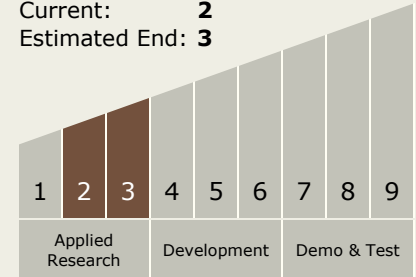
Extreme Access Flyer to Take Planetary Exploration Airborne
(<https://techport.nasa.gov/file/22010>)

NASA Is Building Drones To Search For Resources On The Moon And Mars
(<https://techport.nasa.gov/file/22094>)

NASA Wants This Gas-Jet Drone to Find Resources on the Moon and Mars
(<https://techport.nasa.gov/file/22095>)

Technology Maturity (TRL)

Start: **2**
Current: **2**
Estimated End: **3**



Technology Areas

Primary:

- TX07 Exploration Destination Systems
 - └ TX07.1 In-Situ Resource Utilization
 - └ TX07.1.1 Destination Reconnaissance and Resource Assessment